

REMARKS

Applicants have amended their specification to correct a typographical error, and to be consistent with the drawings figures as presently amended, so as to refer to electrolyte membrane "13" and separate thermoplastic sheets "11", in connection with the description of Fig. 3; to refer to thermoplastic sheets "19", and to refer to "anode" plates "4" and cathode plates "3" in connection with the description of Fig. 6; to describe an external cathode terminal "27", in connection with description of Fig. 7; and to describe unit cell "39" and cell fixing plates "32", in connection with the description of Fig. 9. Noting the original drawing figures, it is respectfully submitted that these amendments to the specification do not add new matter to the application.

Applicants have amended the original Abstract, providing a Substitute Abstract, this Substitute Abstract being in a single paragraph and avoiding terms not to be included in Abstracts, and further describing the presently claimed invention.

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled claims 1-3 without prejudice or disclaimer, and have added new claim 14 to the application, claim 14 being the sole independent claim being considered on the merits in the present application. Specifically, claim 14 recites a sheet chemical cell including an electrolyte membrane having slots, with a plurality of anodes and a plurality of cathodes respectively formed on one face and the other face of the membrane, the anodes and cathodes constituting respective pairs. Claim 14 recites that the cell also includes a plurality of first wiring plates and a plurality of second wiring plates respectively covering the respective anodes and the respective cathodes, and wherein the first wiring plates and the second plates are connected through the respective slots. Preambles of claims 4 and 5 have been amended in

light of new claim 14, and claim 4 has been further amended to be dependent on claim 14. Claims 4 and 5 have been further amended to recite anodes and cathodes, as compared with previously recited anode and cathode plates; and claim 5 has been further amended to recite "a" catalyst of the anodes and of the cathodes, and to recite "a" main ingredient of this catalyst of the anodes and of the cathodes.

In addition to claim 14, Applicants are adding new claims 15-23 to the application. Claims 15 and 16, each dependent on claim 14, respectively recites that the slots are filled with an insulating sealant; and that the first and second wiring plates are electrically connected with each other. Claims 17 and 18, dependent respectively on claims 14 and 17, respectively recites that the sheet chemical cell further includes a plastic sheet as a cover of the sheet chemical cell; and recites that the first and second wiring plates, and the plastic sheet, are provided with through-holes through which fuel and oxygen are supplied. Claims 19 and 20, each dependent on claim 14, respectively recites that the slots are formed around the cathodes and anodes; and that respective slots are positioned between adjacent anodes and adjacent cathodes. Claim 21, dependent on claim 14, recites that a slot, of the slots recited in claim 14, is independently provided between every two adjoining anodes and between every two adjoining cathodes; and claims 22 and 23, dependent respectively on claims 21 and 14, recites that not every slot is used for electrical connection.

In connection with all of the newly added claims, note, for example, Figs. 5 and 6, and the description in connection therewith on pages 17-20 of Applicants' specification.

The restriction requirement set forth in Item 1 on pages 2 and 3 of the Office Action mailed May 22, 2006, is noted. Applicants confirm their election of the

Group I claims, and note that withdrawn claims 9-11 have been retained in the above-identified application, subject to the filing of a Divisional application directed to the subject matter thereof.

Objections to the drawings as set forth in Items 5-9 on pages 4-6 of the Office Action mailed May 22, 2006, are noted. It is respectfully submitted that these objections are moot, in light of present amendments to the specification and drawing figures, and in light of the following.

Thus, in view of amendments to the specification and to the drawing figures, it is respectfully submitted that the reference characters referred to by the Examiner in Item 5 on page 4 of the Office Action mailed May 22, 2006, have been added to the specification, or are already in the specification, or have been deleted from the drawing figures. Specifically, reference characters 11, 13, 19, 32, 35 and 39 have been added to the specification. Reference characters 16 and 38 previously were set forth in the specification, e.g., in the first full paragraph on page 18, and in the paragraph bridging pages 21 and 22, of Applicants' specification. In addition, reference characters 31 and 33 have been deleted from the drawings, in the enclosed Replacement Sheet 5/5 of Figs. 9 and 10. In view of present amendments to the specification and to the drawing figures, and in view of the foregoing, it is respectfully submitted that objection to the drawings as set forth in Item 5 on page 4 of the Office Action mailed May 22, 2006, is moot.

Applicants have amended their specification in the second full paragraph on page 19, in connection with the description of Fig. 6, to recite "anode" plates "4" and cathode plates "3"; in view thereof, it is respectfully submitted that the objections to the drawings as set forth in Items 6 and 7 on pages 4 and 5 of the Office Action mailed May 22, 2006, are moot.

In light of Replacement Sheet 3/5 showing reference character "5" in each of Figs. 5 and 6, it is respectfully submitted that the objection to the drawings as set forth in Item 8 on pages 5 and 6 of the Office Action mailed May 22, 2006, is moot; and in light of Replacement Sheet 4/5 showing, in addition to reference character 27, reference character --27'-- for one set of the electrode terminals, it is respectfully submitted that the objection to the drawings as set forth in Item 9 on page 6 of the Office Action mailed May 22, 2006, is moot.

Applicants provide a Substitute Abstract; in light thereof, it is respectfully submitted that the reminder of the proper language and format for an Abstract, set forth in Item 10 on page 6 of the Office Action mailed May 22, 2006, has been followed. In addition, in light of amendment of the specification at line 17 on page 19, the required correction of spelling of the term "anode" has been satisfied.

Applicants respectfully traverse the rejection of their claims under the second paragraph of 35 USC 112, set forth in Items 14-19 on pages 7 and 8 of the Office Action mailed May 22, 2006, particularly insofar as this rejection is applicable to the present claims. Initially, note that Applicants have cancelled claims 1-3 without prejudice or disclaimer; and, moreover, present claims recite a "sheet chemical cell", and do not use the phrase "sheet-like". In light thereof, bases for rejection of the claims under the second paragraph of 35 USC 112, set forth in Items 15-17 on page 7 of the Office Action mailed May 22, 2006, is moot.

In light of amendment of claim 5 to recite "a" catalyst of the anodes and of the cathodes, and "a" main ingredient thereof, it is respectfully submitted that bases for rejection of claim 5 under the second paragraph of 35 USC 112, set forth in Items 18 and 19 on page 8 of the Office Action mailed May 22, 2006, are moot.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims in the Office Action mailed May 22, 2006, that is, the teachings of the U.S. patent documents to Kidai, et al., United States Patent Application Publication No. 2005/0074651, and to Choi, U.S. Patent No. 6,689,502, and Japanese Patent Document No. 2000-268836, Japanese Patent Document No. 09-223507, and Japanese Patent Document No. 06-131918, under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a sheet chemical cell as in the present claims, including, inter alia, the electrolyte membrane having slots, and a plurality of first wiring plates covering respective anodes and a plurality of second wiring plates covering respective cathodes, and wherein the first wiring plates and the second wiring plates are connected through respective slots. See claim 14.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such sheet chemical cell as in the present claims, having features as discussed previously in connection with claim 14, and, additionally, wherein the slots are filled with an insulating sealant (see claim 15); and/or wherein the slots are formed around the anodes and cathodes (see claim 19), in particular, wherein the respective slots are positioned between adjacent anodes and adjacent cathodes (see claim 20), or wherein a slot, of the recited slots, is independently provided between every two adjoining anodes and between every two adjoining cathodes (see claim 21); and/or wherein not every slot is used for electrical connection (see claims 22 and 23);

and/or wherein the first and second wiring plates are electrically connected with each other (see claim 16); and/or wherein the cell further includes a plastic sheet as a cover of the sheet chemical cell (see claim 17), with the first and second wiring plates and the plastic sheet being provided with through-holes through which fuel and oxygen are supplied (see claim 18); and/or wherein the anodes and cathodes are porous membranes prepared by a slurry containing specified components as in claim 4, with catalyst of the anodes and catalyst of the cathodes as in claim 5.

The present invention relates to a sheet chemical cell, particularly useful, for example, in fuel cells such as a direct methanol fuel cell (DMFC) using methanol and water as fuel, or a polymer electrolyte fuel cell (PEFC).

There have been attempts to develop smaller power generators that need no recharging, e.g., as power sources for recent electronic devices such as mobile telephone sets, book-type personal computers, audiovisual equipment and mobile information terminal equipment. As one of such power generators meeting requirements of small size, and a power supply of higher energy density and of longer running periods (in particular, that need no recharging), a fuel cell power supply has been discussed. Types of fuel cells being proposed for power supplies for electronic devices discussed in the foregoing include polymer electrolyte fuel cells and direct methanol fuel cells. Direct methanol fuel cells show promise as oxygen is supplied to the outer surfaces of a cathode, in contact with outside air, so that this type of power generation device does not require any auxiliary machine to supply the fuel and the oxidizing agent, simplifying the fuel cell system. However, each individual cell of the direct methanol fuel cell has a very low output voltage, e.g., 0.3-0.4V; therefore, to generate an output voltage to power portable electronic devices, the unit cells must be connected in series. As described in the last paragraph on

page 5 of Applicants' specification, these unit cells are serially connected in the anode-to-cathode manner to generate a voltage for powering the portable electronic equipment. However, previously proposed fuel cells having such series connection are very complicated to manufacture, and the manufacturing method is time-consuming, because the unit cells must be electrically connected in series. It can be appreciated, as the number of units cells to be connected increases, the problem becomes more severe. Furthermore, each unit cell must be sealed to prevent leaks, which limits the energy density of the cell.

Against this background, Applicants provide a sheet chemical cell which is simple and easy to fabricate, providing unit cells which can be connected in series so as to achieve sufficient output voltage. Moreover, the cells according to the present invention can have a relatively small thickness. Applicants have found that by providing the electrolyte membrane with slots, and with first and second wiring plates respectively formed on the anodes and cathodes and being connected with each other through these slots formed in the electrolyte membrane, the structure can be manufactured by simple and efficient processing steps, providing a structure which has a relatively small thickness. By sealing these slots with an insulating material, leakage through the membrane can be avoided.

As described in the first two paragraphs on page 8 of Applicants' specification, the unit cells are electrically connected in series, in parallel or both to output desired high voltages and currents, and fuel cells utilizing the sheet chemical cells of the present invention can run portable electronic equipment as referred to on page 8 of Applicants' specification. As for advantages achieved by the present invention, note, for example, the sole full paragraph on page 22, and the paragraph bridging pages 22 and 23, of Applicants' specification.

No. 2000-268836 discloses a power generating device having a negative electrode 11 to oxidize fuel and a positive electrode 12 to reduce oxygen, provided opposing each other, with an electrolyte layer 13 interposed therebetween. This patent document discloses a liquid fuel storage part provided adjacent the negative electrode 11, with a liquid fuel impregnation part 15 provided adjacent to this negative electrode, the part 15 being formed from a resin of polyperfluorosulfonic acid.

No. 09-223507 discloses a solid polymer unit cell having a negative electrode 2 formed on an inside surface of hollow yarn 1 of solid polymer electrolyte, and a positive electrode 3 formed on an outside surface, with fuel supplied to the negative electrode side and an oxidizing agent supplied to the positive electrode side. Mutual electrodes formed on outside and inside surfaces in this unit cell are respectively connected in parallel to each other, and are formed as parallel connection cell use.

It is respectfully submitted that neither of No. 2000-268836 or No. 09-223507 would have disclosed or would have suggested the sheet chemical cell of the present claims, including the electrolyte membrane with slots formed therethrough, together with the wiring plates connected through the respective slots, and advantages thereof, as discussed in the foregoing.

Note that the Examiner has rejected only claim 1 over the teachings of either of No. 2000-268836 and of No. 09-223507, and has not rejected Applicants' prior claims reciting that the chemical cell further includes slots, over the teachings of either of these two Japanese patent documents.

Kidai, et al. discloses a polymer electrolyte membrane, and a polymer electrolyte-type fuel cell (PEFC) using this membrane. The membrane includes a polymer film with collimated pores, having a proton conductor in the collimated

pores, the collimated pores extending in a vertical direction, with a specified relative standard deviation between centers of the adjacent collimated pores. See paragraphs [0015] and [0017] on page 2 of this patent document. Note also paragraphs [0056], [0059], [0061] and [0064] on pages 5 and 6 of this patent document. Note also paragraphs [0085] and [0086] on page 8; and paragraphs [0096] and [0097] on page 9, of this patent document. As applied by the Examiner, note especially Fig. 6 and the description in connection therewith in paragraph [0054] on page 4 of this patent document.

Note that in Fig. 6 of Kidai, et al., electrodes (7) are described with electron conducting area (5) being electrically connected to the electrode substrate or an electrode catalyst layer of a cell. Note, especially, paragraphs [0056]-[0059] on page 5 of this document. It is respectfully submitted that this disclosure in Kidai, et al. would have neither taught nor would have suggested such sheet chemical cell as in the present claims, including, inter alia, wherein the first wiring plates and the second wiring plates, covering the respective anodes and respective cathodes, respectively, are connected through the respective slots, and advantages thereof in, e.g., providing a relatively thin cell.

Choi discloses a cell pack of a direct methanol fuel cell, having structure described most generally in the paragraph bridging columns 2 and 3 of this patent. This patent discloses that the cell includes upper and lower plates spaced a predetermined distance apart from each other, with an ion exchange membrane provided therebetween, a plurality of first anodes installed in each single cell region on the first surface of the membrane and a plurality of first cathodes disposed in each single cell region adjacent to each of the anodes, a plurality of second cathodes installed in each single cell region on a second surface of the ion exchange

membrane corresponding to the first anodes, and a plurality of second anodes corresponding to the first cathodes, first and second anodes current collectors installed on the first and second anodes and each having a fuel passage region, first and second cathode current collectors installed on the first and second cathodes, with a plurality of first conductive portions electrically connecting the first anode and cathode adjacent to each other on the first surface of the ion exchange membrane and a plurality of second conductive portions electrically connecting the second anode and cathode adjacent to each other on the second surface of the ion exchange membrane to electrically connect in series cells provided in the single cell region. Note also, for example, column 5, lines 29-34 of Choi. As a background to Choi, this patent discloses a conventional monopolar cell pack shown in Figs. 2A and 2B, with anodes 2a disposed at one side of an ion exchange membrane 1a and cathodes 3a corresponding to the anodes 2a disposed at the opposite side, with series-connection being provided by a connection wire connecting the anode 2a and cathode 3a of neighboring cells by passing through the ion exchange membrane 1a between the anode 2a and the cathode 3a, a path or hole for passage for this connection wire being provided in the ion exchange membrane 1a. This patent document discloses that the conventional monopolar cell pack has a disadvantage that the path or hole is likely to cause leakage of fuel, so that the path or hole portion should be sealed. See column 2, lines 12-24.

Even taking the teachings of Choi as a whole, including the background thereof, it is respectfully submitted that the disclosure thereof would have neither taught nor would have suggested such sheet chemical cell as in the present claims, including the electrolyte membrane having slots, together with first and second wiring

plates, connected through respective slots, and advantages thereof as discussed previously.

Even assuming, arguendo, that the Examiner has correctly interpreted the teachings of Choi, in Item 24 on pages 12 and 13 of the Office Action mailed May 22, 2006, it is respectfully submitted that such disclosure would have neither taught nor would have suggested the membrane having slots, together with connection of the plurality of first wiring plates covering the respective anodes and the plurality of second wiring plates covering the respective cathodes through the respective slots, and advantages thereof.

Even taking the teachings of either or both of Kidai, et al. and/or Choi in combination with the teachings of Japanese Patent Document No. 6-131918, such combined teachings would have neither disclosed nor would have suggested the present invention, including the electrolyte membrane with slots, and first and second wiring plates as defined in the present claims, connected through the respective slots; and/or other features of the present invention, and advantages thereof.

Each of Kidai, et al. and of Choi has been previously discussed.

No. 6-131918 discloses a flexible wiring sheet having multiple conductors 33-36 formed from one end to the other end on one face of a flexible lengthy sheet 32, the conductors 33-36 being electrically connected with the first conductor sections 33a-36a made of a resistive conducting material having relatively low resistance and the second conductor sections 33b-36b made of a resistive conducting material having relatively high resistance to obtain a flexible wiring sheet 31.

Even assuming, arguendo, that the teachings of No. 6-131918 were properly combinable with the teachings of either and/or both of Kidai, et al. and Choi, such

combined teachings would have neither disclosed nor would have suggested the electrolyte membrane having slots, with plurality of first wiring plates and plurality of second wiring plates covering respective anodes and cathodes, respectively, and these wiring plates being connected through the respective slots, and advantages thereof, as discussed previously; and/or other features of the present invention as discussed in the foregoing, and advantages thereof.

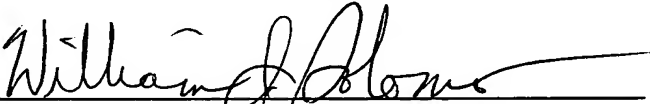
It is emphasized that according to Choi, the intent is to provide a cell pack wherein electrical connections are only on one side of the ion exchange membrane (that is, electrodes on one side are connected to each other, and electrodes on the other side are connected to each other, without connection through the membrane). It is respectfully submitted that the disclosure of Choi, either alone or in combination with disclosures of other references as applied by the Examiner, would have taught away from the structure including the membrane having slots, with connection through such slots, as in the present invention. It is respectfully submitted that modification of Choi to provide connection through the membrane would destroy Choi for its intended purpose, of providing electrical contact only at respective sides of the membrane, in forming series connection; and, accordingly, such modification of Choi would have been improper under the guidelines of 35 USC 103. See In re Ratti, 123 USPQ 349 (CCPA 1959).

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

Applicants request any shortage in fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (case 520.43227X00), and credit any excess payment of fees to such Deposit Account.

Respectfully submitted,

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AMENDMENTS TO THE DRAWINGS:

Please delete original drawings figures Figs. 5-10 on Sheets 3/5, 4/5 and 5/5, and substitute therefor Replacement Sheets 3/5, 4/5 and 5/5, as in the enclosed Appendix. In these Replacement Sheets, reference character 5 has been added to each of Figs. 5 and 6, showing the slot 5 in electrolyte membrane 1. Figs. 7 and 8 have been revised to change the two lower external terminals 27 in each of Figs. 7 and 8 to external cathode terminals 27', and in Fig. 8 one of the upper external terminals has been designated by reference character 27 (which is described in the specification as external anode terminal 27). Figs. 9 and 10 have been revised to delete the reference characters 31 and 33.